

Notice of Allowability

Application No.

09/815,376

Applicant(s)

HOLCOMB ET AL.

Examiner

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to the amendment of 9/13/05 and the tele. int. of 3/17/06.
2. ☒ The allowed claim(s) is/are 8-44.
3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some* c) ☐ None of the:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
- (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
- 1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
- (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

- | | |
|---|---|
| 1. <input type="checkbox"/> Notice of References Cited (PTO-892) | 5. <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 2. <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 6. <input checked="" type="checkbox"/> Interview Summary (PTO-413),
Paper No./Mail Date <u>3/17/06</u> . |
| 3. <input type="checkbox"/> Information Disclosure Statements (PTO-1449 or PTO/SB/08),
Paper No./Mail Date _____ | 7. <input checked="" type="checkbox"/> Examiner's Amendment/Comment |
| 4. <input type="checkbox"/> Examiner's Comment Regarding Requirement for Deposit
of Biological Material | 8. <input type="checkbox"/> Examiner's Statement of Reasons for Allowance |
| | 9. <input type="checkbox"/> Other _____. |

EXAMINER'S AMENDMENT

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with James R. Young on March 17, 2006.

The application has been amended as follows:

In the title:

changed the title to --A METHOD OF USING A COMBINATION DIFFERENTIAL AND ABSOLUTE PRESSURE TRANSDUCER FOR CONTROLLING A LOAD LOCK--

In the claims:

rewrote the claims as follows:

canceled claims 1-3 and 45

Claim 8. A method of automatically controlling a load lock that facilitates transfer of parts between a room at ambient atmospheric pressure and a vacuum transfer or processing chamber maintained at a pressure less than one torr and that has an evacuable load lock chamber, an exterior door positioned between the load lock chamber and the room, a interior door positioned between the load lock chamber and the transfer or processing chamber, a exterior door actuator that is responsive to an

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exterior door control signal to open or close the exterior door, an interior door actuator that is responsive to an interior door control signal to open or close the interior door, and a vacuum pump connected to the load lock chamber for evacuating the load lock chamber, comprising:

~~connecting~~ providing a modular differential and absolute pressure transducer, ~~which that~~ includes a housing, which contains both a pirani pressure sensor, ~~that is capable of measuring absolute pressure at least in a range of 100 torr to 10⁻⁴ torr~~ and a differential pressure sensor, and a control circuit, with both of the sensors being in fluid flow relation to a manifold and the pirani pressure sensor being capable of measuring absolute pressure at least in a range of 100 torr to 10⁻⁴ torr as well as ~~a control circuit in a housing;~~

connecting the pressure transducer via one fluid flow connection of the manifold to the load lock chamber to expose both said pirani pressure sensor and said differential pressure sensor to pressure in the load lock chamber via said one fluid flow connection so that said modular differential and absolute pressure transducer senses and transduces ~~absolute~~ said pressure in the load lock chamber to a first voltage that is indicative of the ~~absolute~~ pressure in the load lock chamber and senses and transduces a differential pressure between the pressure in the load lock chamber and the ambient atmosphere ~~atmospheric pressure~~ to a second voltage that is indicative of the differential pressure between the pressure of the load lock chamber and the ambient atmosphere ~~atmospheric pressure~~, whereby said modular differential and

absolute pressure transducer also outputs the interior door control signal when the first voltage ~~that is indicative of the absolute pressure~~ equals an interior door control reference voltage and outputs the exterior door control signal when the second voltage ~~that is indicative of the differential pressure~~ equals an exterior door control reference voltage;

setting the interior door control reference voltage of the modular differential and absolute pressure transducer to a level that equals ~~the~~ a voltage that is indicative of the ~~absolute~~ pressure in the load lock chamber when the load lock chamber is evacuated to a pressure at which the interior door is to be opened;

setting the exterior door control reference voltage of the modular differential and absolute pressure transducer to a level that equals ~~the~~ a voltage that is indicative of the differential pressure between the pressure of the load lock chamber and the ambient atmosphere ~~atmospheric pressure~~ at which the exterior door is to be opened;

connecting an interior door control link between the modular differential and absolute pressure transducer and the interior door actuator and connecting an exterior door control link between the modular differential and absolute pressure transducer and the exterior door actuator; and

powering the circuitry in the modular differential and absolute pressure transducer to produce the interior door control signal and the exterior door control signal in sequence as the load lock chamber is evacuated and then re-

filled with gas such that the modular differential and absolute pressure transducer: (i) provides the interior door control signal to the interior door actuator via the interior door control link to open the interior door ~~when the load lock chamber has been evacuated to a pressure that is low enough so that the voltage that is indicative of the absolute pressure equals the interior door control reference voltage~~; and (ii) provides the exterior door control signal to the exterior door actuator via the exterior door control link to open the exterior door ~~when the load lock chamber has been re-filled with gas to return the pressure in the load lock chamber to a pressure at which the voltage that is indicative of the differential pressure equals the exterior door control reference voltage~~.

Claim 9. A method of automatically controlling a load lock that facilitates transfer of parts between a room at ambient atmospheric pressure and a vacuum transfer or processing chamber maintained at a pressure less than one torr and that has an evacuable load lock chamber, an exterior door positioned between the load lock chamber and the room, a interior door positioned between the load lock chamber and the transfer or processing chamber, a exterior door actuator that is responsive to an exterior door control signal to open or close the exterior door, an interior door actuator that is responsive to an interior door control signal to open or close the interior door, a vacuum pump connected to the load lock chamber for evacuating the load lock chamber, and a throttle valve, which ~~slows down effective vacuum pumping~~

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~~speed~~ regulates a flow of gas from the load lock chamber and which is responsive to a throttle valve control signal ~~to then step up the vacuum pumping speed~~, comprising:

connecting a modular differential and absolute pressure transducer in fluid flow relation to the load lock chamber via one fluid flow connection so that a pirani sensor and a differential pressure sensor, both in a housing of the modular differential and absolute pressure transducer, ~~are both in fluid flow relation to~~ said load lock chamber via said one connection, ~~whereby said pirani sensor in the modular differential and absolute pressure transducer is being~~ capable of sensing an absolute pressure in the load lock chamber at least in a range of 100 torr to 10^{-4} torr and said differential pressure sensor ~~in the modular differential and absolute pressure transducer is being~~ capable of sensing a differential pressure between the absolute pressure in the load lock chamber and the ambient atmospheric pressure, and wherein the modular differential and absolute pressure transducer also has circuitry in the housing connected to the pirani sensor and to the differential pressure sensor that is capable of transducing both the absolute pressure sensed by the pirani sensor and the differential pressure sensed by the differential pressure sensor to electric signals indicative of said absolute and differential pressure as well as of outputting: (i) the ~~throttle valve control~~ signal at a settable intermediate absolute pressure set point; (ii) the interior door control signal at a settable low absolute pressure set point; and (iii) the exterior door control signal at a settable differential pressure setpoint;

setting said intermediate absolute pressure set point at an intermediate absolute pressure value which is less than 100 torr ~~at which to actuate the throttle valve to increase the vacuum pumping speed~~, setting said low absolute pressure set point at a low absolute pressure value which is less than said intermediate absolute pressure value ~~to cause~~ and at which the interior door is to be opened, and setting said differential pressure set point ~~for~~ at a differential pressure value at which ~~to open the exterior door~~ is to be opened;

sensing the ~~actual~~ absolute pressure in the load lock chamber with the modular pressure transducer at least in the range from 100 torr down to the ~~desired~~ said low absolute pressure value;

using the modular differential and absolute pressure transducer to compare the ~~actual~~ sensed absolute pressure in the load lock chamber to said intermediate absolute pressure set point in the modular differential and absolute pressure transducer, and, when the ~~actual~~ sensed absolute pressure in the load lock chamber equals said intermediate absolute pressure set point, producing the throttle ~~valve control~~ signal with the modular differential and absolute pressure transducer and delivering said throttle ~~valve control~~ signal to the throttle ~~valve to step up the vacuum pumping speed~~ increase the rate at which gas in said load lock chamber is removed;

using the modular differential and absolute pressure transducer to compare the ~~actual~~ sensed absolute pressure in the load lock chamber to said low absolute pressure set point in the modular differential and absolute pressure

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transducer, and, when the ~~actual~~sensed absolute pressure in the load lock chamber equals said low absolute pressure set point, producing the interior door control signal with the modular differential and absolute pressure transducer and delivering the interior door control signal to the interior door actuator to cause the interior door to open;

sensing the ~~actual~~-differential pressure between the ambient pressure in the room and the pressure in the load lock chamber with the modular differential and absolute pressure transducer; and

using the modular differential and absolute pressure transducer to compare the ~~actual~~sensed differential pressure to the differential pressure set point, and, when the ~~actual~~sensed differential pressure equals the differential pressure set point, producing the exterior door control signal with the modular differential and absolute pressure transducer and delivering the exterior door control signal to the exterior door actuator to cause the exterior door to open.

Claim 10. The method of claim 9, wherein the transfer or processing chamber is maintained at a pressure of less than 10^{-3} torr and the low absolute pressure set point at ~~which the interior door can be opened~~ is set at a pressure of less than 10^{-3} torr, and ~~including~~-sensing the ~~actual~~-absolute pressure in the load lock chamber with the modular differential and absolute pressure transducer at pressure levels at least from 100 torr to less than 10^{-3} torr.

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Claim 11. A method of ~~providing control signals to~~controlling a load lock that has an interior door between the load lock and a transfer or processing chamber and that has an interior door actuator that responds to an interior door control signal to open the interior door, a vacuum pump for evacuating the load lock, a throttle valve ~~that slows the vacuum pump down speed~~controls a rate of flow of gas from the load lock and that responds to a throttle valve control signal ~~to step up the pump down speed~~, and an exterior door for opening and closing the load lock to the ambient atmosphere and an exterior door actuator that responds to an exterior door control signal to open the exterior door, comprising:

~~connecting~~ providing a modular pressure transducer comprising a housing that contains: (i) both a pirani pressure sensor and a differential pressure sensor in fluid flow relation to a manifold that is also part of the modular pressure transducer, and mounting the pirani pressure sensor and the differential pressure sensor together with (ii) a control circuit connected electrically to the pirani sensor and to the differential pressure sensor ~~a housing to provide a;~~

connecting the manifold of the modular pressure transducer to the load lock so that the modular pressure transducer that: (i) connects both the pirani pressure sensor and the differential pressure sensor in fluid flow relation to the load lock chamber ~~via~~ with one connector connection of the modular pressure transducer to the load lock; (ii) senses and transduces absolute pressure in the manifold to a first voltage that is indicative of the absolute pressure in the manifold ; (iii) that senses and transduces a differential pressure between the

pressure in the manifold and the ambient ~~atmosphere~~ atmospheric pressure to a second voltage that is indicative of the differential pressure between the pressure in the manifold and the ambient ~~atmosphere~~ atmospheric pressure; and (iv) outputs the throttle ~~valve~~ control signal when the first voltage that is indicative of ~~absolute pressure~~ equals a throttle ~~valve~~ control reference voltage, outputs the interior door control signal when the first voltage that is indicative of the ~~absolute pressure~~ equals an interior door control reference voltage, and outputs the exterior door control signal when the second voltage that is indicative of the ~~differential pressure~~ equals an exterior door control reference voltage;

setting the throttle ~~valve~~ control reference voltage of the modular pressure transducer to a level that equals the a voltage that is indicative of the ~~absolute~~ an intermediate pressure in the load lock ~~when the load lock is evacuated to a intermediate pressure at which the stepped-up pump-down speed is to be~~ actuated;

setting the interior door control reference voltage of the modular pressure transducer to a level that equals the a voltage that is indicative of the ~~absolute~~ a low pressure in the load lock ~~when the load lock is evacuated to a low pressure~~ at which opening of the interior door is to be actuated;

setting the exterior door control reference voltage of the modular pressure transducer to a level that equals the a voltage that is indicative of the differential pressure between the pressure in the load lock and the ambient ~~atmosphere~~ atmospheric pressure at which opening of the exterior door is to be actuated;

~~connecting the manifold of the pressure transducer in fluid flow relation to the load lock with said one connector so that the pressure in the manifold is the same as the pressure in the load lock;~~

~~establishing a throttle valve control link between the modular pressure transducer and the throttle valve;~~

~~establishing an interior door control link between the modular pressure transducer and the interior door actuator;~~

~~establishing an exterior door control link between the modular pressure transducer and the exterior door actuator; and~~

~~powering the modular pressure transducer to produce the throttle valve control signal, the interior door control signal, and the exterior door control signal in sequence as the load lock is evacuated and then re-filled with gas such that the pressure transducer: (i) provides the throttle valve control signal to the throttle valve via the throttle valve control link to step up the pump down speed when the load lock has been evacuated to said intermediate pressure at which the stepped up pump down speed is to be actuated; (ii) provides the interior door control signal to the interior door actuator via the interior door control link to actuate the opening of the interior door when the load lock has been evacuated to said low pressure at which the opening of the interior door is to be actuated; and (iii) provides the exterior door control signal to the exterior door actuator via the exterior door control link to actuate the opening of the exterior door when the~~

~~load lock has been refilled with gas to return the pressure in the load lock to a pressure at which the opening of the exterior door is to be actuated.~~

Claim 12. The method of claim 11, wherein the low ~~absolute~~ pressure at which the opening of the interior door is to be actuated is less than 10^{-3} torr and the modular pressure transducer produces the interior door control signal when it senses that ~~absolute~~ said low pressure.

Claim 13. The method of claim 11, wherein the low ~~absolute~~ pressure at which the opening of the interior door is to be actuated is in a range between 10^{-3} and 10^{-4} torr, and wherein the modular pressure transducer senses ~~when the load lock is evacuated to such low absolute pressure between 10^{-3} and 10^{-4} torr to produce~~ and generates the interior door control signal at ~~that~~ said low ~~absolute~~ pressure.

Claim 14. The method of claim 11, wherein the low ~~absolute~~ pressure at which the opening of the interior door is to be actuated is at least as low as 10^{-4} torr, and wherein the modular pressure transducer senses when the load lock is evacuated to at least as ~~low as 10^{-4} torr to produce~~ said low pressure and generates the interior door control signal at ~~that~~ said low ~~absolute~~ pressure.

Claim 15. The method of claim 11, including routing the throttle ~~valve~~ control signal, the interior door control signal, and the exterior door control signal to the throttle ~~valve~~

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control link, to the interior door control link, and to the exterior door control link, respectively, through a common connector on the housing, and connecting the throttle ~~valve~~-control link, the interior door control link, and the exterior door control link to the common connector.

Claim 16. The method of claim 8, including routing the interior door control signal and the exterior door control signal to the interior door control link and to the exterior control link, respectively, through a common connector on the housing, and connecting the interior door control link and the exterior door control link to the common connector.

Claim 17. The method of claim 8, wherein the load lock has a throttle valve that slows ~~the vacuum pump down speed~~ regulates a flow of gas from the load lock chamber and that responds to a throttle valve control signal to ~~step up the pump down speed~~, and wherein the modular pressure transducer also outputs ~~the a~~ throttle valve control signal ~~when the voltage that is indicative of absolute pressure in the manifold equals a throttle valve reference voltage~~, and further including setting the throttle valve control reference voltage of the modular pressure transducer to a level that equals the voltage that is indicative of the absolute pressure in the load lock chamber ~~when the load lock chamber is evacuated to an intermediate pressure at which the stepped up pump down speed is to be actuated~~, and thereby producing the throttle valve control signal with the ~~powered modular pressure transducer to step up the pump down speed when the load lock chamber is evacuated to said intermediate pressure~~ to control the throttle.

Claim 18. The method of claim 8, wherein the pirani sensor is a regular pirani sensor.

Claim 19. A method of automatically controlling a load lock that facilitates transfer of parts between a room at ambient atmospheric pressure and a vacuum transfer or processing chamber maintained at a pressure less than one torr and that has an evacuable load lock chamber, an exterior door positioned between the load lock chamber and the room, a interior door positioned between the load lock chamber and the transfer or processing chamber, a exterior door actuator that is responsive to an exterior door control signal to cause the exterior door to open, an interior door actuator that is responsive to an interior door control signal to cause the interior door to open, and a vacuum pump connected to the load lock chamber for evacuating the load lock chamber, comprising:

~~connecting~~ providing a modular differential and absolute pressure transducer comprising a housing, which ~~has~~ contains circuitry and both an absolute pressure sensor and a differential pressure sensor in fluid flow relation to each other, ~~;~~ and

connecting the absolute pressure sensor and the differential pressure sensor of the modular differential and absolute pressure transducer in fluid flow relation to the load lock chamber via one connection to ~~provide a modular differential and absolute pressure transducer, which also includes circuitry in a housing, that senses~~ sense and ~~transduces~~ transduce absolute pressure in the

load lock chamber to a first voltage which is indicative of the absolute pressure and ~~that sense~~to sense and ~~transduces~~transduce differential pressure between the pressure in the transducer and the ambient ~~atmosphere~~atmospheric pressure to a second voltage which is indicative of the differential pressure, and ~~that to also output~~output said interior door control signal when the first voltage ~~which is indicative of the absolute pressure in the load lock chamber equals an~~ interior door control reference voltage and ~~outputs~~output said exterior door control signal when the second voltage ~~which is indicative of the differential pressure in the load lock chamber and the ambient atmosphere equals an~~ exterior door control reference voltage;

setting the interior door control reference voltage of the modular differential and absolute pressure transducer to a level that equals ~~the~~a voltage that is indicative of the absolute pressure in the load lock chamber when the load lock chamber is evacuated to a pressure at which the interior door is to be opened;

setting the exterior door control reference voltage of the modular differential and absolute pressure transducer to a level that equals ~~the~~a voltage that is indicative of the differential pressure between the load lock chamber pressure and the ambient ~~atmosphere~~atmospheric pressure at which the exterior door is to be opened;

establishing an interior door control link between the modular differential and absolute pressure transducer and the interior door actuator, and establishing

an exterior door control link between the modular differential and absolute pressure transducer and the exterior door actuator; and

powering the modular differential and absolute pressure transducer circuitry to produce said interior door control signal to open the interior door and said exterior door control signal to open said exterior door in sequence as the load lock chamber is evacuated and then re-filled with gas ~~such that the modular differential and absolute pressure transducer: (i) provides said interior door control signal to the interior door actuator via the interior door control link to open the interior door when the load lock chamber has been evacuated to a pressure that is low enough so that the voltage that is indicative of the absolute pressure equals the interior door control reference voltage; and (ii) provides said exterior door control signal to the exterior door actuator via the exterior door control link to open the exterior door when the load lock chamber has been re-filled with enough gas to return the pressure in the load lock chamber to a pressure at which the voltage that is indicative of the differential pressure equals the exterior door control reference voltage.~~

Claim 20. A method of automatically controlling a load lock that facilitates transfer of parts between a room at ambient atmospheric pressure and a vacuum transfer or processing chamber maintained at a pressure less than one torr and that has an evacuable load lock chamber, an exterior door positioned between the load lock chamber and the room, a interior door positioned between the load lock chamber and

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the transfer or processing chamber, a exterior door actuator that is responsive to an exterior door control signal to cause the exterior door to open, an interior door actuator that is responsive to an interior door control signal to cause the interior door to open, and a vacuum pump connected to the load lock chamber for evacuating the load lock chamber, comprising:

connecting a modular differential and absolute pressure transducer in fluid flow relation to the load lock chamber via a single fluid flow connection, wherein the modular differential and absolute pressure transducer includes a housing that contains both an absolute pressure sensor, which is capable of sensing absolute pressure in the load lock chamber, and a differential pressure sensor, which is capable of sensing a differential pressure between the load lock chamber pressure and the ambient atmospheric pressure, whereby both said absolute pressure sensor and said differential pressure sensor are in fluid flow relation to said load lock chamber as a result of said single fluid flow connection of the modular pressure transducer to the load lock chamber, said modular differential and absolute pressure transducer also including control circuitry in the housing that is capable of outputting: (i) said interior door control signal at a settable low absolute pressure set point; and (ii) said exterior door control signal at a settable differential pressure set point;

setting a low absolute pressure value in the modular differential and absolute pressure transducer which corresponds to the pressure in the load lock

chamber at which the interior door can be opened to allow transfer of the parts between the load lock chamber and the transfer or processing chamber;

setting a differential pressure value in the modular differential and absolute pressure transducer at which to open the exterior door;

using the modular differential and absolute pressure transducer to sense both the ~~actual~~-absolute pressure in the load lock chamber and the differential pressure between the load lock chamber pressure and the ambient ~~atmosphere~~atmospheric pressure;

using the control circuitry in the modular differential and absolute pressure transducer to compare the ~~actual~~-sensed absolute pressure in the load lock chamber to said low absolute pressure value set in the modular differential and absolute pressure transducer ~~at which the interior door can be opened~~, and, when the ~~actual~~-sensed absolute pressure in the load lock chamber equals the said low absolute pressure value, to generate ~~produce~~ said interior door control signal, and delivering said interior door control signal to the interior door actuator, which thereby causes the interior door to open; and

using the control circuitry in the modular differential and absolute pressure transducer to compare the ~~actual~~-sensed differential pressure to ~~the~~ said differential pressure value ~~at which to open the exterior door~~, and, when the ~~actual~~-sensed differential pressure equals said differential pressure value, to generate ~~produce~~ said exterior door control signal, and delivering said exterior

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door control signal to the exterior door actuator, which thereby causes the exterior door to open.

Claim 21. A method of automatically controlling a load lock that facilitates transfer of parts between a room at ambient atmospheric pressure and a vacuum transfer or processing chamber maintained at a pressure less than one torr and that has an evacuable load lock chamber, an exterior door positioned between the load lock chamber and the room, a interior door positioned between the load lock chamber and the transfer or processing chamber, a exterior door actuator that is responsive to an exterior door control signal to open or close the exterior door, an interior door actuator that is responsive to an interior door control signal to open or close the interior door, a vacuum pump connected to the load lock chamber for evacuating the load lock chamber, and a throttle, which ~~slows down effective vacuum pumping speed to reduce turbulence that stirs up particles and contaminants until the pressure in the load lock is pumped down to an intermediate pressure where enough of the air or gases in the load lock are removed so that turbulence does not stir up such particles and~~ controls a rate at which gas is removed from said load lock chamber and which is responsive to a throttle control ~~signal to then step up the vacuum pumping speed,~~ comprising:

controlling the throttle, the interior door actuator, and the exterior door actuator with a modular differential and absolute pressure transducer, which comprises a housing that contains an absolute pressure sensor and ~~one, but not~~

~~more than one,~~ a differential pressure sensor, and which is connected to the load lock chamber via a single fluid flow connection in a manner that exposes both the absolute pressure sensor and the differential pressure sensor ~~in of the~~ modular differential and absolute pressure transducer to pressure in the load lock chamber via said single fluid flow connection to the load lock chamber, said modular differential and absolute pressure transducer also including circuitry in the housing that is capable of producing all of the following: (i) said throttle control signal at a settable first absolute pressure set point; (ii) said interior door control signal at a settable second absolute pressure set point; and (iii) said exterior door control signal at a settable differential pressure setpoint;

setting the first absolute pressure setpoint in the modular differential and absolute pressure transducer;

setting the second absolute pressure setpoint in the modular differential and absolute pressure transducer;

setting the differential pressure setpoint in the modular differential and absolute pressure transducer;

operating the vacuum pump to evacuate the load lock chamber;

sensing the pressure in the load lock chamber with the modular differential and absolute pressure transducer while the load lock chamber is being evacuated, ~~whereupon reaching~~ and when the modular differential and absolute pressure transducer senses that the pressure in the load lock chamber has reached the first absolute pressure setpoint, the modular differential and

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absolute pressure transducer ~~produces~~ generates said throttle control signal, and ~~whereupon reaching~~ when the modular differential and absolute pressure transducer senses that the pressure in the load lock chamber has reached the second absolute pressure setpoint, the modular differential and absolute pressure transducer ~~produces~~ generates said interior door control signal to activate said interior door actuator; and

refilling the load lock chamber and thereby increasing the pressure in the ~~load lock~~ load lock chamber while sensing the differential pressure between the load lock chamber pressure and the ambient ~~atmosphere~~ atmospheric pressure with the modular differential and absolute pressure transducer, ~~whereupon reaching~~ and when the modular differential and absolute pressure transducer senses that the pressure in the load lock chamber has reached the differential pressure setpoint, the modular pressure transducer ~~produces~~ generates said exterior door control signal to activate said exterior door actuator.

Claim 22. A method of automatically controlling a load lock that facilitates transfer of parts between a room at ambient atmospheric pressure and a vacuum transfer or processing chamber maintained at a pressure less than one torr and that has an evacuable load lock chamber, an exterior door positioned between the load lock chamber and the room, a interior door positioned between the load lock chamber and the transfer or processing chamber, a exterior door actuator that is responsive to an exterior door control signal to open or close the exterior door, an interior door actuator

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that is responsive to an interior door control signal to open or close the interior door, a vacuum pump connected to the load lock chamber for evacuating the load lock chamber, comprising:

controlling the interior door actuator and the exterior door actuator with a modular pressure transducer ~~that has one, but not more than one,~~ which comprises a housing that contains an absolute pressure sensor and one, but not more than one, a differential pressure sensor, and which is connected to the load lock chamber ~~with one, but not more than one,~~ via a single fluid flow connection in a manner that exposes both the absolute pressure sensor and the differential pressure sensor ~~in of~~ the modular differential and absolute pressure transducer to pressure in the load lock chamber via said ~~one single~~ connection to the load lock chamber, said modular differential and absolute pressure transducer also including circuitry in the housing that is capable of ~~producing~~ generating said interior door control signal at a settable absolute pressure set point and said exterior door control signal at a settable differential pressure setpoint;

setting the absolute pressure setpoint in the modular differential and absolute pressure transducer;

setting the differential pressure setpoint in the modular differential and absolute pressure transducer;

operating the vacuum pump to evacuate the load lock chamber;

sensing the pressure in the load lock chamber with the modular differential and absolute pressure transducer while the load lock chamber is being evacuated, ~~whereupon reaching~~ and when said modular differential and absolute pressure

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transducer senses that the pressure in the load lock chamber has reached said absolute pressure setpoint, the modular differential and absolute pressure transducer ~~produces~~ generates said interior door control signal to activate said interior door actuator; and

refilling the load lock chamber and thereby increasing the pressure in the load lock chamber while sensing differential pressure between the load lock chamber pressure and the ambient ~~atmosphere~~ atmospheric pressure with the modular differential and absolute pressure transducer, ~~whereupon reaching~~ and when said modular differential and absolute pressure transducer senses that the pressure in the load lock chamber has reached the differential pressure setpoint, the modular pressure transducer ~~produces~~ generates said exterior door control signal to activate said exterior door actuator.

Claim 23. A method of automatically controlling a load lock that facilitates transfer of parts between a room at ambient atmospheric pressure and a vacuum transfer or processing chamber maintained at a pressure less than one torr and that has an evacuable load lock chamber, an exterior door positioned between the load lock chamber and the room, a interior door positioned between the load lock chamber and the transfer or processing chamber, a exterior door actuator that is responsive to an exterior door control signal to open or close the exterior door, an interior door actuator that is responsive to an interior door control signal to open or close the interior door, a vacuum pump connected to the load lock chamber for evacuating the load lock

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chamber, and a throttle, ~~which slows down effective vacuum pumping speed to reduce turbulence that stirs up particles and contaminants until the pressure in the load lock is pumped down to an intermediate pressure where enough of the air or gases in the load lock are removed so that turbulence does not stir up such particles and contaminants~~ and which is responsive to a throttle control signal ~~to then step up the vacuum pumping speed,~~ comprising:

controlling the throttle and the exterior door actuator with a modular pressure transducer ~~that has one, but not more than one,~~ which comprises a housing that contains an absolute pressure sensor and ~~one, but not more than one,~~ a differential pressure sensor, and which is connected to the load lock chamber with ~~one, but not more than one,~~ a single fluid flow connection in a manner that exposes both the absolute pressure sensor and the differential pressure sensor in the modular differential and absolute pressure transducer to pressure in the load lock chamber via said ~~one single~~ fluid flow connection to the load lock chamber, said modular differential and absolute pressure transducer also including circuitry in the housing that is capable of ~~producing~~ generating both said throttle control signal at a settable first absolute pressure set point and said exterior door control signal at a settable differential pressure setpoint;

setting the first absolute pressure setpoint in the modular pressure transducer;

setting the differential pressure setpoint in the modular pressure transducer;

operating the vacuum pump to evacuate the load lock chamber;

sensing the pressure in the load lock chamber with the modular pressure transducer while the load lock chamber is being evacuated, ~~whereupon reaching~~ and

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when said modular differential and absolute pressure transducer senses that the pressure in the load lock chamber has reached the first absolute pressure setpoint, the modular pressure transducer ~~generates~~ produces said throttle control signal; and

refilling the load lock chamber and thereby increasing the pressure in the load lock chamber while sensing differential pressure between the load lock chamber pressure and the ambient ~~atmosphere~~ atmospheric pressure with the modular pressure transducer, ~~whereupon reaching~~ and when said modular differential and absolute pressure transducer senses that the pressure in the load lock chamber has reached the differential pressure setpoint, the modular pressure transducer ~~generates~~ produces said exterior door control signal to activate said exterior door actuator.

Claim 24. The method of claim 23, including also controlling the interior door actuator with the modular pressure transducer by setting a second absolute pressure setpoint in the modular pressure transducer lower than said first absolute pressure setpoint, and continuing to sense the pressure in the load lock chamber with the modular pressure transducer as said vacuum pump continues to evacuate the load lock chamber after the first absolute pressure setpoint is reached, ~~whereupon reaching~~ and when said modular differential and absolute pressure transducer senses that the pressure in the load lock chamber has reached said second absolute pressure setpoint, the modular pressure transducer ~~produces~~ generates said interior door control signal.

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Claim 25. The method of claim 21, wherein the absolute pressure sensor is capable of measuring absolute pressure at least from 100 torr to 10^{-4} torr.

Claim 26. The method of claim 21, wherein the absolute pressure sensor is a pirani sensor.

Claim 27. The method of claim 2621, wherein the absolute pressure sensor is a regular pirani sensor.

Claim 28. The method of claim 2621, wherein the absolute pressure sensor is a convection pirani sensor.

Claim 29. The method of claim 21, wherein the absolute pressure sensor is a thermocouple sensor.

Claim 30. The method of claim 21, wherein the differential pressure sensor is a capacitance manometer pressure sensor.

Claim 31. The method of claim 21, wherein the differential pressure sensor is a piezo pressure sensor.

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Claim 32. A method of automatically controlling a load lock that facilitates transfer of parts between a room at ambient atmospheric pressure and a vacuum transfer or processing chamber maintained at a pressure less than one torr and that has an evacuable load lock chamber, an exterior door positioned between the load lock chamber and the room, a interior door positioned between the load lock chamber and the transfer or processing chamber, a exterior door actuator that is responsive to an exterior door control signal to open or close the exterior door, an interior door actuator that is responsive to an interior door control signal to open or close the interior door, a vacuum pump connected to the load lock chamber for evacuating the load lock chamber, comprising:

mounting an absolute pressure sensor and a differential pressure sensor along with electric circuitry together in a housing to provide a modular differential and absolute pressure transducer, which is capable of transducing electric signals from the absolute and differential pressure sensors ~~and to produce~~ generate said interior door control signal and said exterior door control signal at respective absolute pressure and differential pressure setpoints, and making a single fluid flow connection of the modular pressure transducer ~~to~~ with the load lock chamber to expose both the absolute and differential pressure sensors in the modular pressure transducer to a pressure in the load lock chamber via said single connection;

operating the vacuum pump to evacuate the load lock chamber while sensing the ~~absolute pressure~~ in the load lock chamber with the absolute pressure sensor in said modular pressure transducer so that, upon ~~pumping~~ sensing that the pressure in the

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load lock chamber is at least down to the absolute pressure setpoint, the circuitry in the modular differential and absolute pressure transducer ~~produces~~ generates and transmits said interior door control signal to the interior door actuator to cause the interior door to be opened; and

back-filling the load lock chamber with gas to increase the pressure in the load lock chamber while sensing the differential pressure between the load lock chamber pressure and the ambient ~~atmosphere~~ atmospheric pressure with the modular differential and absolute pressure transducer so that, upon back-filling the load lock chamber with at least enough gas to reach said ~~absolute~~ differential pressure setpoint, the circuitry in the modular differential and absolute pressure transducer ~~produces~~ generates and transmits said exterior door control signal to the exterior door actuator to cause the exterior door to be opened.

Claim 33. A method of automatically controlling a load lock that facilitates transfer of parts between a room at ambient atmospheric pressure and a vacuum transfer or processing chamber maintained at a pressure less than one torr and that has an evacuable load lock chamber, an exterior door positioned between the load lock chamber and the room, a interior door positioned between the load lock chamber and the transfer or processing chamber, a exterior door actuator that is responsive to an exterior door control signal to open or close the exterior door, an interior door actuator that is responsive to an interior door control signal to open or close the interior door, a

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vacuum pump connected to the load lock chamber for evacuating the load lock chamber, comprising:

controlling the interior door actuator and the exterior door actuator with a modular pressure transducer ~~that has one, but not more than one, which comprises a housing that contains an~~ absolute pressure sensor and ~~one, but not more than one, a~~ differential pressure sensor, and which is connected to the load lock chamber with ~~one, but not more than one, a single~~ fluid flow connection in a manner that exposes both the absolute pressure sensor and the differential pressure sensor in the pressure transducer to pressure in the load lock chamber via said ~~one single~~ connection to the load lock chamber, said modular pressure transducer also including electric circuitry in the housing that is capable of ~~producing~~ generating: (i) said interior door control signal at a absolute pressure setpoint that is set at a absolute pressure value at which the ~~the~~ interior door is to be opened; and (ii) said exterior door control signal at a differential pressure setpoint that is set at a differential pressure value at which the exterior door is to be opened;

sensing the pressure in the load lock chamber with the modular pressure transducer while operating the vacuum pump to evacuate the load lock chamber at least to the absolute pressure setpoint, whereupon after sensing that the load lock chamber pressure has reached said absolute pressure set point, the modular pressure transducer ~~produces~~ generates said interior door control signal to cause said interior door to be opened; and

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sensing the differential pressure between the load lock chamber pressure and the ambient ~~atmosphere~~ atmospheric pressure with the modular differential and absolute pressure transducer while refilling the load lock chamber with gas or air and thereby increasing the pressure in the load lock chamber at least until the differential pressure reaches the differential pressure setpoint, whereupon the pressure transducer ~~produces~~ generates said exterior door control signal to cause said exterior door to be opened.

Claim 34. The method of claim 21, including making said ~~one~~ single fluid flow connection to the load lock chamber with a connector that also supports the modular pressure transducer, including both the absolute and differential pressure sensors and the circuitry, on the load lock.

Claim 35. The method of claim 9, wherein the pirani sensor is a regular pirani sensor.

Claim 36. The method of claim 9, including using a manifold to make said one fluid flow connection to the load lock chamber so that the pirani sensor and the differential pressure sensor in the modular pressure transducer are both in fluid flow relation to the load lock chamber.

Claim 37. The method of claim 19, including using a manifold to connect the absolute and differential pressure sensors in the modular differential and absolute pressure

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transducer in fluid flow relation to each other and in fluid flow relation to the load lock chamber.

Claim 38. The method of claim 19, wherein the absolute pressure sensor is a ~~regular~~ pirani sensor.

Claim 39. The method of claim ~~38~~19, wherein the absolute pressure sensor is a regular pirani sensor.

Claim 40. The method of claim ~~19~~38, wherein the absolute pressure sensor is a ~~regular~~ convection pirani sensor.

Claim 41. The method of claim 19, wherein the absolute pressure sensor is a thermocouple sensor.

Claim 42. The method of claim 19, wherein the differential pressure sensor is a capacitance manometer pressure sensor.

Claim 43. The method of claim 19, wherein the differential pressure sensor is a piezo pressure sensor.

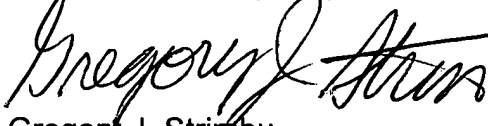
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Claim 44. The method of claim 20, including using a manifold to facilitate connecting said modular differential and absolute pressure transducer to the load lock chamber with both said absolute pressure sensor and said differential pressure sensor in said modular differential and absolute pressure transducer ~~sensor~~ being in fluid flow relation to said manifold.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Gregory J. Strimbu whose telephone number is 571-272-6836. The examiner can normally be reached on Monday through Friday 8:00 to 4:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Richard Chilcot can be reached on 571-272-6777. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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